WHITE STURGEON PRODUCTIVITY STATUS AND HABITAT REQ. 8605000

SHORT DESCRIPTION:
Describe and restore white sturgeon productivity in Columbia and Snake river reservoirs by determining population dynamics parameters, quantifying available spawning habitat, experimentally supplementing depressed populations, monitoring tribal and recreational fisheries, and recommending hydrosystem operation strategies.

SPONSOR/CONTRACTOR: ODFW
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SUB-CONTRACTORS:
National Marine Fisheries Service (NMFS)Washington Department of Fish and Wildlife (WDFW)U.S. Fish and Wildlife Service (USFWS)Biological Resources Division of U.S. Geologic Survey (BRD)Columbia River Inter-Tribal Fish Commission

GOALS

GENERAL:
Supports a healthy Columbia basin, Maintains biological diversity, Maintains genetic integrity, Increases run sizes or populations, Provides needed habitat protection, Adaptive management (research or M&E), Program coordination or planning, Basinwide

RESIDENT FISH:
Habitat, Production, Research, M&E

NPPC PROGRAM MEASURE:
10.4A.1, 10.4A.2, 10.4A.3, and 10.4A.5

RELATION TO MEASURE:
Project will conduct work that will contribute to description of spawning and rearing habitat requirements and availability, description of stock genetics, assessing stock status, incidence of diseases that are known from hatchery stocks in the wild population, development of annual and long-term recommendations for sturgeon management and restoration, providing elements of a biological risk assessment that describes means to restore sturgeon populations between Bonneville Dam and the mouth of the Snake River, and provide a base-line assessment of white sturgeon for application by others in Lake Roosevelt from Grand Coulee Dam to the international border.

BIOLOGICAL OPINION ID:
Project has provided and continues to provide basic information about white sturgeon spawning habitat requirements, life history, and productivity parameters that are used in the Kootenai Sturgeon Biological Opinion.

OTHER PLANNING DOCUMENTS:
ite Sturgeon Management Framework Plan (Hanson, D.L., et al. 1992. Pacific States Marine Fisheries Commission. Portland, Oregon). The plan "provides a broad view of white sturgeon resources, identifies research issues of regional importance, and suggests a framework within which individual resource agencies and Native American tribes can develop appropriate management schemes". With assistance from members of the Sturgeon Management T A Review of Alternatives for the Restoration and Management of White Sturgeon Populations and Fisheries in the Columbia River Between Bonneville and McNary Dams (Zone 6). (DeVore et al. 1997)

TARGET STOCK	LIFE STAGE	MGMT CODE (see below)
Lake Roosevelt White Sturgeon	All life stages W	W
Little Goose Reservoir White Sturgeon	All life stages	W
Lower Granite Reservoir to Hells Canyon Dam	All life stages	W
Lower Monumental Reservoir White Sturgeon	All life stages	W
Ice Harbor Reservoir White Sturgeon	All life stages	W

McNary Reservoir and Hanford Reach White Sturgeon	All life stages	W
John Day Reservoir White Sturgeon	All life stages	W; S
The Dalles Reservoir White Sturgeon	All life stages	W; S
Bonneville Reservoir White Sturgeon	All life stages	W; N

AFFECTED STOCK	BENEFIT OR DETRIMENT
Introduced resident fishes	Recommend spring flows at McNary Dam may decrease recruitment of walleye.
Native resident fishes	Beneficial. Recommend spring flows at McNary Dam will likely benefit those resident fishes that evolved in a more riverine habitat.
Anadromous Salmonids	Beneficial. Recommend spring flows at McNary Dam have similar timing and magnitude to those for outmigrating juvenile salmonids.

BACKGROUND

STREAM AREA AFFECTED

Stream name:

Mainstem Columbia River Bonneville to Border with Canada, Snake River mouth to Lower Granite Dam

Stream miles affected:

710 miles

Hydro project mitigated:

Bonneville, The Dalles, John Day, and McNary dams

HISTORY:

This project has been and is a cooperative effort among many agencies. The current cooperators are Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Biological Resources Division of U.S. Geologic Survey (BRD), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and Columbia River Inter-Tribal Fish Commission (CRITFC).

The study was designed to describe reproduction and early life history characteristics of white sturgeon populations, life history and population dynamics of subadult and adult white sturgeon, define habitat requirements for spawning and rearing of white sturgeon, quantify the extent of habitat available, and evaluate the need and potential methods for protecting, mitigating, and enhancing white sturgeon.

1986-1992: research results can be found in a two volume report and at least 14 published articles.

1993: model development was continued to describe effects of hydropower plant operation on spawning. Project was extended into the McNary Pool, the mid Columbia below Priest Rapids Dam, and the Snake River below Ice Harbor Dam. Conducted preliminary sampling to describe status, distribution, spawning and recruitment there.

1994: Provided updated status of populations in Bonneville and The Dalles reservoirs. Habitat mapping, and egg and larval sampling to describe spawning above McNary Dam.

1995: Experimental transplants of sublegal white sturgeon from below Bonneville Dam to The Dalles Reservoir to evaluate a means supplementing reduced productivity. Intensive sampling to describe specific, proximate effects of hydrosystem operations on spawning. Sampling to describe population characteristics above McNary Dam. Habitat mapping continued.

1996: Experimental transplant repeated. Habitat mapping above McNary Dam continued. Provide updated status of population in John Day Reservoir. Sonic- and radio-tracking to describe habitat usage by subadult and adult white sturgeon. Sampling to describe population characteristics in Ice Harbor Reservoir.

1997: Evaluation of survival, growth and condition of transplanted fish. Habitat mapping above McNary Dam continued. Sonic- and radio-tracking to describe habitat usage by subadult and adult white sturgeon continued. Laboratory experiments to increase precision of back-calculated spawning dates and allow correlations with specific hydrosystem operations. Sampling to describe population characteristics in Lower Monumental and Little Goose reservoirs. Sub-contract to identify genetic markers for use in describing genetic stock composition.

BIOLOGICAL RESULTS ACHIEVED:

Documented an 85% reduction in sturgeon productivity between Bonneville and McNary dams because of impoundment and oper

ations (measured in harvestable pounds / acre/ year). Identified spawning habitat and access as the key limiting factor. Determined low spring flows decrease spawning habitat and sturgeon recruitment. Identified the importance of protecting spawner broodstock (females > 6 feet). Arrested declining trends and started rebuilding sturgeon populations. Preserved limited harvest and fishing opportunities for reservoir sturgeon populations. Project results were the justification for flows for Kootenai River sturgeon restoration. Results provide a sound quantitative basis for predicting the benefits of flow measures and reservoir drawdown on sturgeon production. Results have been used to develop models for application in management strategies.

PROJECT REPORTS AND PAPERS:

We have produced 16 peer-reviewed journal publications which document the scientific basis for protection and restoration efforts. Work has been internationally recognized by other sturgeon managers and researchers, with invitation to several symposiums and workshops.

Annual Reports

Status and habitat requirements of the white sturgeon populations downstream from McNary Dam: Annual Reports for 1988-DOE/BP-63584-2, 1989-DOE/BP-63584-3, 1990-DOE/BP-63584-4, 1991-DOE/BP-63584-5, 1993-DOE/BP-63584-6, 1993-DOE/BP-63584-7; and Effects of Mitigative Measures on Productivity of White Sturgeon Populations in the Columbia River Downstream from McNary Dam 1994-DOE/BP-63584-8, 1995-DOE/BP-63584-9, and 1996-DOE/BP-63584-10 are available.

Technical Papers

Beamesderfer, R.C. 1991. MOCPOP 2.0: A flexible system for simulation of age-structured populations and stock related functions. Oregon Department of Fish and Wildlife Information Report 91-4.

Beamesderfer, R.C. 1993. A standard weight (Ws) equation for white sturgeon. California Fish and Game 79(2):63-69}

Beamesderfer, R.C.P., T.A. Rien, and A.A. Nigro. 1995. Dynamics and potential production of white sturgeon populations in three Columbia River reservoirs Transactions of the American Fisheries Society 124:857-872.

DeVore, J.D., B.W. James, C.A. Tracy, and D.A. Hale. 1995. Dynamics and potential production of white sturgeon in the Columbia River downstream from Bonneville Dam. Transactions of the American Fisheries Society 124:845-856.

Elliott J.C. and R.C. Beamesderfer. 1990. Comparison of efficiency and selectivity of three gears used to sample white sturgeon in a Columbia River reservoir. California Fish and Game 76(3):174-180.

McCabe, G.T., Jr. 1993. Prevalence of the parasite Cystoopsis acipenseri (Nematoda) in juvenile white sturgeons in the lower Columbia River. Journal of Aquatic Animal Health 5(4):313-316.

McCabe, G.T., Jr. and L.G. Beckman. 1990. Use of an artificial substrate to collect white sturgeon eggs. California Fish and Game 76(4):248-250.

McCabe, G.T., Jr., R.L. Emmett, and S.A. Hinton. 1993. Feeding ecology of juvenile white sturgeon (Acipenser transmontanus) in the Lower Columbia River. Northwest Science 67(3):170-180.

North, J.A., R.C. Beamesderfer, and T.A. Rien. 1993. Distribution and movements of white sturgeon in three lower Columbia River reservoirs. Northwest Science 67(2):105-111.

Parsley, M.J., and L.G. Beckman. 1994. White Sturgeon spawning and rearing habitat in the Lower Columbia Rive. North American Journal of Fisheries Management 14:812-827.

Parsley, M.J., L.G. Beckman, and G.T. McCabe, Jr. 1993. Spawning and rearing habitat use by white sturgeons in the Columbia River downstream from McNary Dam. Transactions of the American Fisheries Society 122(2):217-227.

Rien, T.A. and R.C. Beamesderfer. 1994. Accuracy and precision in age estimates of white sturgeon from pectoral fin rays. Transactions of the American Fisheries Society 123(2):255 265.

Rien, T.A., R.C.P. Beamesderfer, and C.A. Foster. 1994. Retention, recognition, and effects on survival of several tags and marks on white sturgeon. California Fish and Game 80(4):161-170.

Warren, J.J. and L.G. Beckman. 1993. Fishway use by white sturgeon to bypass mainstem Columbia River dams. U.S. Fish and Wildlife Service Sea Grant Extension Project, Columbia River Series WSG-AG 93-02.

ADAPTIVE MANAGEMENT IMPLICATIONS:

Key findings and recommendations based on this projects findings are summarized on pages 9-16 in Volume 1 of our 1993 Final Report for phase 1 work. The management implications of research to date are now being compiled in a document with the working title: "A review of alternatives for the restoration and management of white sturgeon populations and fisheries in the Columbia River between Bonneville and McNary dams (Zone 6)".

The top three recommendations are: 1) Reduced flows limit spawning habitat and recruitment of white sturgeon. A 250 Kcfs minimum instantaneous discharge at McNary Dam when water temperatures are 13-15 C will provide white sturgeon spawning habitat in all three Zone 6 pools. Lesser discharges do not provide spawning habitat in John Day Reservoir. Greater discharges provide more spawning habitat. Detailed recommendations for operation of the hydropower system are one of the objectives for current research. 2) The density and potential harvest for populations in The Dalles and John Day reservoirs are limited by poor

recruitment. Supplementing recruitment through transplantation or hatchery releases should be initiated and evaluated. Supplementation evaluation or implementation should continue until increased flows restore recruitment. 3) Sturgeon are isolated in each reservoir. No individual reservoir fully meets the life history needs of the sturgeon isolated there and the dynamics of each reservoir population are unique. Therefor management strategies should be tailored to optimize production and offset effects of impoundment based on the unique attributes of each impounded population and each population must be closely monitored to maintain optimum exploitation rates.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

1. Experimentally implement and evaluate success of selected measures to protect and enhance populations and mitigate for effects of the hydropower system on productivity of white sturgeon in the Columbia River downstream from McNary Dam.
1.1. Evaluate success of developing and implementing a management plan for white sturgeon in reservoirs between Bonneville and McNary dams in enhancing production.
1.2. Evaluate growth, mortality, and contributions to fisheries of juvenile white sturgeon transplanted from areas downstream from The Dalles Dam to areas in The Dalles and John Day reservoirs.
1.3. Evaluate white sturgeon spawning and recruitment downstream from McNary Dam under recommended flows and project operations.
2. Continue to examine and develop promising new measures to protect and enhance populations and mitigate for effects of the hydropower system on productivity of white sturgeon in the Columbia River downstream from McNary Dam.
2.1. Evaluate levels and assess effects of contaminants found in the Columbia River downstream from McNary Dam (e.g. organochlorine pesticides, PCB's, dioxins and furans, and trace elements) on production of white sturgeon populations.
2.2. Assess quantity and quality of habitat available for use by subadult and adult white sturgeon downstream from McNary Dam.
2.3. Identify and evaluate approaches to supplement recruitment of wild populations of white sturgeon downstream from McNary Dam.
3. Evaluate the need and identify potential measures for protecting and enhancing populations and mitigating for effects of the hydropower system on productivity of white sturgeon in the Columbia and Snake rivers upstream from McNary Dam.
3.1. Describe reproductive and early life history characteristics of white sturgeon in the Columbia and Snake rivers upstream from McNary Dam and downstream from Bonneville Dam.
3.2. Describe the life history and population dynamics of subadult and adult white sturgeon in the Columbia and Snake rivers upstream from McNary Dam and downstream from Bonneville Dam. Describe the white sturgeon recreational fishery in the Columbia and Snake rivers upstream from McNary Dam.
3.3. Define habitat used for spawning and rearing; and quantify extent of habitat available in the Columbia and Snake rivers upstream from McNary Dam and downstream from Bonneville Dam.
3.4. Assess quantity and quality of habitat available for use by subadult and adult white sturgeon in the Columbia and Snake rivers upstream from McNary Dam.

CRITICAL UNCERTAINTIES:

It is uncertain if restoration recommendations will be funded at an adequate level to allow full recovery of populations. It is uncertain whether flow augmentation designed to enhance spawning and recruitment of impounded sturgeon populations will be implemented due to the conflicting needs of hydropower users. In the absence of flow augmentation, it is uncertain whether the disease and genetic risks relative to artificial propagation are large enough to preclude this enhancement option. It is uncertain if genetic stock composition will limit the geographic scope of transplant supplementation. The geographic limits to supplementation and stock transfers are not known. The genetic compositions of populations isolated by dams have not been adequately described. It is uncertain what densities of sturgeon can be supported in current reservoir habitats.

BIOLOGICAL NEED:

Hydropower development has isolated once anadromous white sturgeons into discrete populations bounded by dams. This has severely restricting movements and made seasonally favorable food supplies and habitat unavailable. Little is known of the life history and habitat needs of this species. This information is needed by fisheries managers to maintain viable populations. In the absence of stock assessment information, sturgeon consumptive harvest cannot be adequately managed for sustainable yields. Hydrosystem operations cannot be shaped to address the spawning needs of impounded sturgeon populations risking future listings of depressed stocks under the Endangered Species Act.

HYPOTHESIS TO BE TESTED:

Natural production of white sturgeon in impounded reaches and reservoirs is less than what it was before development and operation of the hydropower system.
White sturgeon rearing habitat in many impoundments is underseeded because of reductions in spawning habitat caused by hydrosystem development and operations.
White sturgeon production in impoundments can be significantly enhanced by some combination of spawning and rearing habitat restoration (hydrosystem configuration and operation) and supplementation (transplants and artificial propagation).
Naturally spawning white sturgeon populations in impoundments can be preserved and optimum rates of production can be restored while concurrently maintaining limited tribal and recreational fishery opportunities.
White sturgeon productivity in impounded reaches above McNary Dam is equal to productivity in the free-flowing reach below Bonneville Dam.
Transplanted white sturgeon will have similar growth rates and condition factors to native white sturgeon in The Dalles Reservoir.
Habitat use by white sturgeon differs among seasons.
Spawning habitat for white sturgeons in each known spawning area does not differ among years as a result of river discharges and water temperatures that occurred, which in turn are influenced by hydropower system operations.
Recruitment of white sturgeon to young of the year in the Bonneville Reservoir is unrelated to the amount of spawning habitat that occurred during that year.
Recruitment and white sturgeon spawning success is directly related to the quantity of spring flow during times when water temperatures are between 10 and 17 C.
Viral diseases specific to white sturgeon already exist in wild populations of the Columbia River Basin.
Populations that were recently artificially isolated by impoundment are not genetically discrete.

ALTERNATIVE APPROACHES:

1) Fickeisen, D.H. 1985a. White Sturgeon Work Plan. Bonneville Power Administration, Contract No. DE-AI79-85BP22209. Portland, Oregon. and 2) Fickeisen, D.H. 1985b. White Sturgeon Research Program Implementation Plan. Bonneville Power Administration, Contract No. DE-AI79-85BP22209. Portland, Oregon. These documents outline information needs by life history stage and river reach throughout the Columbia and Snake river basins. 3) Multi-Year Implementation Plan (Columbia Basin Fish and Wildlife Authority 1997 Draft). 4) A Review of Alternatives for the Restoration and Management of White Sturgeon Populations and Fisheries in the Columbia River Between Bonneville and McNary Dams (Zone 6) (DeVore et al. 1997).

JUSTIFICATION FOR PLANNING:

This project partially funds two primary planning efforts that involve ODFW, WDFW, and CRITFC. 1) Development of joint annual harvest management in Zone 6 which allows limited Tribal commercial, Tribal subsistence, and recreational harvest on white sturgeon populations in Zone 6. White sturgeon fisheries in Zone 6 are less productive because the hydrosystem has impeded migration and reduced recruitment. 2) Development of a long term plan that recommends alternatives and concurrent efforts to restore white sturgeon populations in the Columbia Basin.

METHODS:

The experimental premise in these studies is that the effects of impoundment on Columbia Basin white sturgeon populations can be determined by comparing critical population dynamics parameters such as growth rate, mortality rate, and reproductive potential between impounded populations and the unimpounded lower Columbia population. Abundance and population dynamics are estimated using standard protocols such as mark and recapture studies, catch curve modeling, and maximum likelihood estimates of parameters used to describe reproductive potential (please refer to published BPA annual reports and journal articles for further detail). All life history stages are being studied in this research effort.
Habitat use by white sturgeon will be described by conducting an analysis of water depth, velocity, and substrate at sites where fish are located through sonic telemetry. Criteria curves defining the suitability of each habitat descriptor will be developed by applying non-parametric tolerance limits to the observations. Fish to be tagged with crystal-controlled high-power sonic transmitters will be captured by setlining. During each seasonal period, twelve fish will be tagged with these transmitters and an additional six fish will be tagged with depth-indicating tags. The fish will be captured and released throughout the study area. Water depths will be measured with recording fathometers, water velocities will be measured with mechanical meters and with an acoustic doppler current profiler, substrates will be determined with dredges and underwater cameras. Habitat will be quantified by using the physical habitat simulation system developed by the USFWS, and by cartographic modeling with a Geographic Information System.

PLANNED ACTIVITIES

SCHEDULE:

Planning Phase **Start** 10/97 **End** 9/98 **Subcontractor** ODFW, WDFW, CRITFC

Task Experimentally capture sublegal white sturgeon in Bonneville Reservoir using a variety of gear types to determine feasibility of transplanting fish into recruitment limited impoundments. Assess relative stress caused by various gear types.

Planning Phase **Start** 10/97 **End** 9/98 **Subcontractor** BRD

Task Experimentally index recruitment of young-of-year white sturgeon in Bonneville, The Dalles and John Day reservoirs using gill nets. Describe distribution, length frequency, relative weight, and catch rate for white sturgeon populations between Priest Rapids and Grand Coulee dams through set line and gill net sampling. Sample Lake Roosevelt using gill nets and set lines to capture young of the year, sub-adults, and adults. Describe abundance, distribution, age composition, growth, and potential productivity of white sturgeon. (In coordination with Upper Columbia United Tribes). Describe spawning habitat use through analysis and compilation of hydraulic simulation data.

Planning Phase **Start** 9/98 **End** 9/98 **Subcontractor** NMFS

Task Describe relative year-class strength for young-of -the-year white sturgeon downstream from The Dalles Dam through catch rates in bottom trawls. Provide control information for young -of-the year indexing. Describe recruitment of young-of-year white sturgeon downstream from Bonneville Dam by trawling to describe density.

Implementation Phase **Start** 10/97 **End** 9/98 **Subcontractor** ODFW, WDFW, CRITFC, NMFS

Task Coordinated monitoring of harvest and effort in commercial, recreational, and subsistence fisheries of Zone 6. Initial transplants of sublegal white sturgeon to The Dalles or John Day reservoirs depending on findings in 1997.

CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:

NA

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

Expected performance of target population or quality change in land area affected:

Upon completion of assessing the Columbia Basin's sturgeon populations, it will likely be determined that populations are more depressed the further upstream in the basin they are found. It is also expected that hydroelectric system development and operation is the primary reason for this loss of production potential. The information we obtain on habitat use by white sturgeons in free-flowing and impounded river reaches will be used to provide estimates of the amount of habitat that is available for spawning and rearing fish. The time series analysis of spawning habitat spanning several years can be used to better understand how operation of the hydropower system affects this habitat and the white sturgeon populations.

Present utilization and convservation potential of target population or area:

Although information on populations upstream from Priest Rapids and Ice Harbor dams is limited, we currently believe all white sturgeon populations upstream from Bonneville Dam are weak but recoverable. Zone 6 supports extremely restricted tribal commercial, tribal subsistence, and recreational harvest fisheries. There are recreational harvest fisheries for white sturgeon in McNary Reservoir and Hanford Reach. In Columbia River reservoirs above Priest Rapids Dam only catch and release fishing is allowed. In Snake River reservoirs downstream from Lower Granite Dam there are recreational harvest fisheries. Upstream from Lower Granite Dam only catch and release fishing is allowed. Kootenai River white sturgeon (which are not included in this project) are endangered.

Assumed historic status of utilization and conservation potential:

From the outset this study has used the potential productivity per unit area below Bonneville Dam as the benchmark for productivity in river reaches upstream from Bonneville Dam. Reduced potential productivity is attributed to changes in habitat and restricted migration resulting from development of the hydrosystem.

Long term expected utilization and conservation potential for target population or habitat:
Management objectives: 1) Restore abundance of naturally produced white sturgeon to the maximum extent allowable by existing habitat capacity given reductions caused by hydropower development and operations. 2) Restore long-term sustainable yield of sturgeon sport and tribal fisheries given that stable brood-stock populations can be maintained under conditions created by hydropower system development and operation. 3) Identify and consider additional mitigation if abundance of naturally produced white sturgeon cannot be restored to levels (harvest 5 kg/ha/yr) sustainable under conditions existing before hydropower system development and operation.

Contribution toward long-term goal:
Stock assessments in areas upstream from McNary Dam will provide detailed information on these white sturgeon populations for the first time ever. Egg sampling in downstream from Lower Monumental, Little Goose, and Lower Granite dams will provide information on distribution and duration of spawning in these reservoirs for the first time ever. Annual trawling below Bonneville and The Dalles dams provides estimates of recruitment for correlation with hydrosystem operations, and early warning of recruitment failures. Harvest estimates from creel surveys allow sustainable fisheries while populations rebuild. Experimental evaluation of transplanting white sturgeon is designed to determine the feasibility of supplementing depressed populations with wild fish from a healthy population. Laboratory experiments on egg and larval development will be used to increase precision of back-calculated spawning time, which will allow correlation with specific operations of the hydrosystem. Habitat mapping and hydraulic simulation allow quantification of available spawning habitat at various flows and will allow recommendations for flow regimes that allow spawning. Description of the genetic composition of white sturgeon in the basin is an essential first step in defining the limits of stock transfers.

Indirect biological or environmental changes:
Recommended minimum flows are consistent with recommended spills for juvenile salmonid emigration. Further refinements in recommendations for hydrosystem configuration to benefit white sturgeon are likely to be beneficial to salmonids as well.

Physical products:
Not very applicable. In recent years we have tagged about 6,000 fish per year in various river reaches. We will likely tag about 4,000 in 1998. About 20 fish will be radio tagged.

Environmental attributes affected by the project:
We anticipate no direct environmental effects from fish tagging operations, evaluations of supplementation, and fisheries monitoring. If flow recommendations are achieved, the hydrosystem will need to be operated differently in low water years. The exact effects depend on specific configurations.

Changes assumed or expected for affected environmental attributes:
N/A

Measure of attribute changes:
N/A

Assessment of effects on project outcomes of critical uncertainty:
Critical uncertainties or risks associated with project implementation and/or outcome were described under "SCIENTIFIC BASIS OR RATIONALE FOR PROJECT" item A. Recommendations from research will be implemented with a phased approach that will allow monitoring and evaluation to steer future efforts. Transplant supplementation will be conducted in geographically close reservoirs until genetic stock composition is better understood. Description of genetic stock composition will include a time frame to assess if and when stocks diverged. If populations are genetically distinct, is that the result of impoundment or did genetically distinct stocks exist before migration was impeded by dams? Initial supplementation with hatchery reared fish will be in reservoirs where there are no realistic options to provide spawning habitat and natural recruitment. This along with conservation minded breeding protocols will limit genetic risks associated with artificial propagation. Monitoring of supplemented populations will assess growth and condition of fish. Correlation with density will allow determination of habitat carrying capacity.

Information products:
The Zone 6 white sturgeon management plan establishes the basis and methodology for managing impounded populations of white sturgeon. It recommends minimum flows that will allow spawning. It recommends strategies for Estimates of catch and effort in Tribal commercial, Tribal subsistence, and recreational harvest are used to monitor adherence to sustainable harvest guidelines in impounded populations. Fisheries are closed when they reach guidelines. Harvest estimates are presented in BPA annual reports.

MONITORING APPROACH
The experimental premise in these studies is that the effects of impoundment on Columbia Basin white sturgeon populations can be determined by comparing critical population dynamics parameters such as growth rate, mortality rate, and reproductive potential between impounded populations and the unimpounded lower Columbia population. Abundance and population dynamics are estimated using standard protocols such as mark and recapture studies, catch curve modeling, and maximum likelihood estimates of parameters used to describe reproductive potential (please refer to published BPA annual reports and journal articles for further detail). All life history stages are being studied in this research effort.
Habitat use by white sturgeon will be described by conducting an analysis of water depth, velocity, and substrate at sites where fish are located through sonic telemetry. Criteria curves defining the suitability of each habitat descriptor will be developed by applying non-parametric tolerance limits to the observations. Fish to be tagged with crystal-controlled high-power sonic transmitters will be captured by setlining. During each seasonal period, twelve fish will be tagged with these transmitters and an additional six fish will be tagged with depth-indicating tags. The fish will be captured and released throughout the study area. Water depths will be measured with recording fathometers, water velocities will be measured with mechanical meters and with an acoustic doppler current profiler, substrates will be determined with dredges and underwater cameras. Habitat will be quantified by using the physical habitat simulation system developed by the USFWS, and by cartographic modeling with a Geographic Information System.

Provisions to monitor population status or habitat quality:
Fishery monitoring and periodic stock assessments will be used to monitor population status.

Data analysis and evaluation:
Research findings are analyzed and reported in annual reports and peer-reviewed journals. recommendations for restoration are reviewed and approved by the Sturgeon Management Task Force and CBFWA.

Information feed back to management decisions:
Recommendations for restoration are reviewed and approved by the Sturgeon Management Task Force and CBFWA.

Critical uncertainties affecting project's outcomes:
Critical uncertainties or risks associated with project implementation and/or outcome were described under "SCIENTIFIC BASIS OR RATIONALE FOR PROJECT" item A. Recommendations from research will be implemented with a phased approach that will allow monitoring and evaluation to steer future efforts. Transplant supplementation will be conducted in geographically close reservoirs until genetic stock composition is better understood. Description of genetic stock composition will include a time frame to assess if and when stocks diverged. If populations are genetically distinct, is that the result of impoundment or did genetically distinct stocks exist before migration was impeded by dams? Initial supplementation with hatchery reared fish will be in reservoirs where there are no realistic options to provide spawning habitat and natural recruitment. This along with conservation minded breeding protocols will limit genetic risks associated with artificial propagation. Monitoring of supplemented populations will assess growth and condition of fish. Correlation with density will allow determination of habitat carrying capacity.

EVALUATION
Stable sturgeon abundance, biomass, age composition, and annual harvest at target levels over a period corresponding to one generation.

Incorporating new information regarding uncertainties:
Recommendations from research will be implemented with a phased approach that will allow monitoring and evaluation to steer f

uture efforts.

Increasing public awareness of F&W activities:
Fishery monitoring programs afford an opportunity to discuss the region's efforts one on one. Presentations about the project are given to community groups through outreach programs of agencies and tribes. We have developed and distributed a pamphlet that gives an overview of region goals and the sturgeon program. Technical results are presented at professional society meetings and in peer-reviewed journals.

RELATIONSHIPS

RELATED BPA PROJECT	RELATIONSHIP
Yakama Indian Nation K-Ponds	Personnel from project 860500 will serve on a technical advisory group to develop a plan for K-Ponds located on the Hanford Site.
Nez Perce Tribe white sturgeon investigations	Project 860500 will continue to provide assistance in work to restore white sturgeon productivity in Lower Granite Reservoir and Hells Canyon.
8806500 Kootenai White Sturgeon Investigations	Findings from project 860500 were the justification for flows sought for Kootenai River sturgeon restoration. Project 860500 continues to provide assistance in egg and larval sampling. Laboratory work to describe timing of larval development will provide direct benefits.
8605000 Funds a variety of studies by the Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Biological Resources Division of USGS, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the Columbi	

RELATED NON-BPA PROJECT	RELATIONSHIP
Status of the White Sturgeon Resource in the Mainstem Columbia River: project funded by the Federal Aid to Fish Restoration Act. Project results from stock assessment in the lower Columbia downstream from Bonneville Dam used as a control for BPA Project 860500. Results also used to manage lower Columbia fisheries.	Shared data and expertise allow use of data from below Bonneville as control information for comparison with the impounded populations.

OPPORTUNITIES FOR COOPERATION:
From its inception this project has been a cooperative effort among many agencies. Our past performance demonstrates a high level of cooperation. We expect this level of cooperation will continue.
Some examples: In 1996 the WDFW provided boats and crews to radio tag white sturgeon in McNary Reservoir and the Hanford Reach when BRD recognized that it would be difficult to capture enough fish for the study design. The ODFW, WDFW, and CRITFC work closely together to conduct a coordinated fishery sampling program. The research programs of ODFW, WDFW, and CRITFC work closely with fisheries managers (through the Sturgeon Management Task Force under the Columbia River Compact) and provide information and develop fish management plans. The WDFW and BRD collaborate on analyses of flow and spawning to provide flow recommendations that provide white sturgeon spawning habitat. ODFW, NMFS, WDFW, CRITFC, and BRD worked cooperatively to transplant juvenile white sturgeon to The Dalles Reservoir. The ODFW, WDFW, and BRD participated in a Biological Risk Assessment Team for white sturgeon in Lower Granite Reservoir and Hells Canyon conducted by the Nez Perce Tribe. The BRD has loaned egg collection mats to the Nez Perce Tribe to test and use as a model for their own design.

COSTS AND FTE

1997 Planned: $2,294,400

FUTURE FUNDING NEEDS:

FY	$ NEED	% PLAN	% IMPLEMENT	% O AND M
1998	$2,650,000	60%	40%	
1999	$2,900,000	10%	90%	
2000	$3,200,000	10%	90%	
2001	$3,500,000	10%	90%	
2002	$3,500,000	10%	90%	

PAST OBLIGATIONS (incl. 1997 if done):

FY	OBLIGATED
1986	$1,656,447
1988	$1,047,071
1989	$1,127,143
1990	$1,203,176
1992	$681,200
1993	$819,500
1994	$1,489,302
1995	$4,083,019
1997	$2,053,815
TOTAL:	$14,160,673

Note: Data are past obligations, or amounts committed by year, not amounts billed. Does not include data for related projects.

FY	OTHER FUNDING SOURCE	AMOUNT	IN-KIND VALUE
1998	Oregon and Washington state general funds	$500,000	
1999	Oregon and Washington state general funds	$550,000	
2000	Oregon and Washington state general funds	$600,000	
2001	Oregon and Washington state general funds	$660,000	
2002	Oregon and Washington state general funds	$660,000	

OTHER NON-FINANCIAL SUPPORTERS:
Columbia River Inter-Tribal Fish Commission, Nez Perce, Umatilla, Warm Springs, and Yakama tribes, and Upper Columbia United Tribes.

LONGER TERM COSTS: $ 3,600,000 for implementation.

1997 OVERHEAD PERCENT: 22%

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:
[Overhead % not provided so BPA appended older data.] Total direct costs.

SUBCONTRACTOR FTE: WDFW 7.75; BRD 6.46; NMFS 0.42; USFWS 3.19; CRITFC 1.25; Yakima Indian Nation 0.77